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# Short Communications

## Canine hip dysplasia in Irish water spaniels: two decades of gradual improvement

B. Freeman, V. B. Evans, N. R. McEwan

CANINE hip dysplasia (CHD) results from incorrect coxofemoral joint development in dogs. Although CHD has been described in many breeds of dog, it is generally regarded as being associated with larger breeds. The breed-susceptibility of the condition prompted the suggestion that there may be genetic component associated with CHD, which has led to a number of investigations being undertaken to calculate heritability values for CHD in a range of breeds of dogs (eg, Wood and others 2000, Wood and others 2002, Lewis and others 2010). The values obtained reiterate the belief that CHD results from a combination of polygenic interactions, where each gene possibly makes variable contributions to the final phenotype (Wilson and others 2011). Various papers have resulted in different heritability scores for different breeds, for example, Labrador retrievers (Wood and others 2002) and Gordon setters (Wood and others 2000); maternal versus paternal effects (Wood and others 2000); and some reporting symmetry of hip scores (Wilson and others 2011) and others a difference between left and right hips (eg, Tsai and others 2007). Hence, it is possible that there may be slight differences in the major causal genes/alleles in different breeds, and in order that a better understanding may be obtained for CHD generically, an argument could be made for individually studying as many breeds as possible. The current work makes a contribution to the understanding of this disorder by investigating hip dysplasia in the Irish water spaniel.

Anonymised breeding records (ie, all names were removed and animals were assigned a number) were obtained for all dogs registered with the UK Irish Water Spaniel Society on or before August 28, 2009, or whose ancestry could be traced from 1901 onwards. Totally, records for 8225 dogs were obtained, of which scores generated as part of a routine screening programme were available for 676 animals. Based on the scoring method of the British Veterinary Association/Kennel Club (1991), where each hip is scored on a scale of 0–53, these animals had a mean combined hip score of 15.3 (sd=10.2). Although there has been a trend towards a small drop in the mean between the combined hip score value for older animals at the time of this method being introduced (dogs born before 1985) and the most recent (dogs born in 2007) figures (13.2 vs 10.1, with 95% CIs of 2.9 and 1.1, respectively), this masks the trend that took place, whereby there was an initial increase in the scores (peaking at 19.7, 95% CI 3.2, in 1992), followed by a recent trend towards a drop over the last two decades.

This suggests that, as a whole, awareness by breeders is leading to a reduction in the level of CHD severity in animals being registered with the society.

No significant difference was detected between males and females ( $15.0 \pm 10.0$  and  $15.4 \pm 10.3$ , respectively), based on an equal variance *t* test ( $P=0.737$ ) which was supported by a prior *F* test. No difference was detected in scores for the right versus left hip ( $7.6 \pm 5.6$  and  $7.6 \pm 5.5$ , respectively) based on a paired *t* test ( $P=0.948$ ). Furthermore, based on a Goodman-Kruskal  $\gamma$  score of 0.555, there was a general trend towards animals having a high hip score for one hip having a likelihood of a high score for the other hip (ie, concordant and not discordant distribution).

In a pair-wise comparison between full siblings, there was poor relationship in hip score values based on a regression plot ( $r^2=0.016$ ). In a similar way, no correlation ( $r^2=0.0006$ ) was found between hip score value and inbreeding coefficient.

When the heritability value ( $h^2$ ) was calculated based on mean square calculations (Wearden, 1959) for pups from all dogs ( $n=15$ ) which sired a minimum of 10 offspring, a value of 0.181 was obtained. Insufficient females produced a minimum of 10 registered offspring to allow a comparable calculation for heritability based on offspring from these females. When the study was extended to look at the  $h^2$  value based on a comparison of the hip score of all pups ( $n=510$ ) versus the mid-parental score, this value was 0.140, with the comparable plots based on the scores from only one parent suggesting that the paternal ( $n=559$ )  $h^2$  value (0.141) was higher than that from the maternal ( $n=546$ )  $h^2$  value (0.106).

The results obtained for the Irish water spaniels share similarities with analyses undertaken in other breeds, while showing some differences from others. Notably, the results show that there is no laterality bias, nor is there a gender bias for pups being registered with the society, and animals which have a higher hip score for one hip, will probably have a higher hip score for the other hip (relatively to other dogs). The heritability values (both by using mean square calculations for specific sires, and plotting pup scores versus mid-parent means) are typical of those seen in other breeds, although the value for pups from more popular sires gave the highest value. However, as with previous observations (Wood and others 2002), the figure based on the sire was higher than that based on the dam, although in the current work, the value for sires was much closer to the value obtained for the mid-parent mean. The difference in the sire/dam single parent values versus the mid-parent values may be a reflection of a small number of sires (relative to the number of dams) being used, or it may be due to some of the parental hip scores only being available for one of the parents, and so not being included in the mid-parent calculations.

In conclusion, work presented here reiterates the fact that CHD is a complex trait, which is almost certainly governed by multiple gene interactions. This is best evidenced by examples in the current work where, historically, two dogs with moderate effects were mated and produced offspring with low scores. This particular breed society has managed to achieve a reduction in the mean score over approximately the last 20 years, but due to the complexity of the condition, the problem has still not been eradicated.

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